

Can NGATS Meet the Demands of the Future?

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Introduction

The JPDO¹ applies an integrated approach to evaluate the effectiveness of NGATS strategies for transforming the National Airspace System (NAS). The central evaluation question is whether the proposed investments of the NGATS will meet the national goals identified in the Integrated National Plan. As a corollary to this central question the JPDO evaluation and analysis team examines the magnitude and types of problems that may arise if the NAS is not expanded to meet future transportation demand.

The NAS is a complex system consisting of a large number of subsystems that interact both operationally and institutionally. This complexity poses unique challenges for the models as well as the opinion and insight of system experts that the JPDO uses to represent the impact of NGATS strategies on NAS. No single analytical model has the scope and flexibility to perform the full range of simulations and calculations required for thorough analyses of the NGATS strategies and their potential impact within a transformed NAS. For that reason the JPDO has linked together a suite of models to represent all components of the NAS from "curb-to-curb". The results of these models are then reviewed by experts who have been convened to supplement the application of the analytical capabilities.

In this paper, we describe: the analytic framework that is being developed for these analyses; how we project the aviation demand that NGATS will have to satisfy; some preliminary results of how well the NGATS meets this demand; and, finally, the next steps in the continuing evaluation of the NGATS transformation.

The Analytic Framework

The JPDO evaluation and analysis team has developed an analytic framework that integrates work from the JPDO Integrated Product Teams (IPTs) and other JPDO working groups. The framework includes models of the important aspects of the NAS, which will be used to assess the effects and effectiveness of the NGATS strategies and action plans.

This assessment will provide a basis for prioritizing investments in a National Plan to transform the NAS and achieve the six National Goals. The assessment will include measures of the operational, economic, environmental, safety and security state of the air transportation system, with and without transformation.

Once NGATS strategies for NAS transformation have been developed within the JPDO by its Integrated Product Teams (IPTs), the salient parts of the evaluation and analysis approach are:

- 1) The development and characterization of one or more "baseline" future scenarios for the demand for air transport services in the NAS.
- 2) The characterization of the JPDO/IPT transformation strategies in terms that permit them to be assessed against the baseline by the JPDO models.
- 3) The evaluation of characterized strategies using the baseline NAS scenario and the JPDO portfolio of modeling tools.
- 4) The quantification of the NAS impacts identified in the strategy evaluation in terms of diverse metrics that describe important aspects of NAS performance.
- 5) An assessment of the extent to which strategies contribute to the achievement of the JPDO National Goals, based on the outcomes for the metrics.

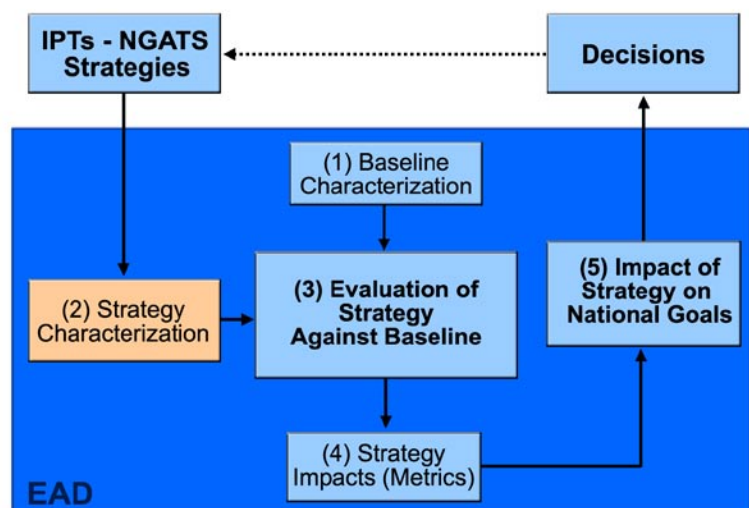


Figure 1 JPDO Strategy Evaluation Process

In addition, a number of policy and regulatory issues related to the goals of the NGATS plan will have to be analyzed in terms of both their individual impact, and in total - on the overall business case for NAS transformation.² Clearly, there will be both complementary and competing technology and policy solutions, as well as disparate timeframes for implementation and return on investment.

The links between these steps in the evaluation and analysis approach are depicted in Figure 1 below. As the figure indicates, the role of the evaluation and analysis team is to provide support to decision-makers and feedback to the IPTs regarding the likely impacts and value of specific transformation strategies defined in the NGATS architecture.

Projecting Aviation Demand

Aviation demand in 2025 will undoubtedly differ from today's demand in many ways. Economic and population growth will continue to increase the demand for passenger and shipping services. Technical and political opportunities and challenges will lead commercial operators to find new ways to provide these services, which will complement and expand the service categories already established in the marketplace. In all cases, the expectation of tomorrow's providers of air transport services is that the NGATS will be able to accommodate their needs in a reliable way. No one can predict precisely what this demand will look like, so we have developed a set of projections that bound what the most likely future will be (figure 2). This will help us in planning for the NGATS, since the NGATS must, in spite of these uncertainties, be capable of accommodating whatever demand it will face in 2025.

The JPDO considers the many sources for uncertainties about the paths that future air transport demand may take and has developed tools and expertise to categorize and understand the sources of variability in aviation demand.

For its baseline forecasts of the nation's aviation demand, the JPDO has primarily used forecasts of aviation activity from the FAA, which are updated and published annually as the FAA Aerospace Forecast and the Terminal Area Forecast (TAF). The JPDO has also used forecasts from industry and other analysts. Between 2004 and 2016, FAA forecasters see domestic RPMs growing at an average annual rate of 3.9 percent, and between 2004 and 2025, they see domestic enplanements growing at an average annual rate of 3.3 percent. Boeing's 2004 Commercial Market Outlook predicts that worldwide passenger demand

(RPMs) will grow at an annual rate of 5.2% between the years 2004 and 2024, with domestic demand growing at an annual rate of 3.5%.

Illustration of Future Demand vs. Current image
However, to analyze the implications of future traffic growth for the future NAS, these growth rates – which are themselves uncertain and subject to variability – are only a starting point. Important and uncertain details about future operations – average aircraft size, the geographical composition of the nation's air carrier airports, the distribution of operations between hub and spoke systems and point to point systems – must also be identified and quantified. Figure 2 illustrates a notional range of forecasts of future enplanements that are considered by the JPDO. As discussed above, this range reflects forecasts from several government and industry sources. Within this range, the growth path for enplanements that is actually realized will be related to actual changes in GDP, airline yields and other factors.

NGATS – A Preliminary Assessment

In its analyses of NGATS end state capabilities the JPDO has also investigated the effects on NGATS goals of such alternatives for air transport demand in future years. These alternatives include innovations in airline business models and innovations in the types of vehicles used to serve future air transport demand. Such alternatives – referred to as "scenarios" – are assessed in terms of their implications for all of the NGATS goals for the National Airspace System.

The JPDO has developed and analyzed a baseline of important characteristics of

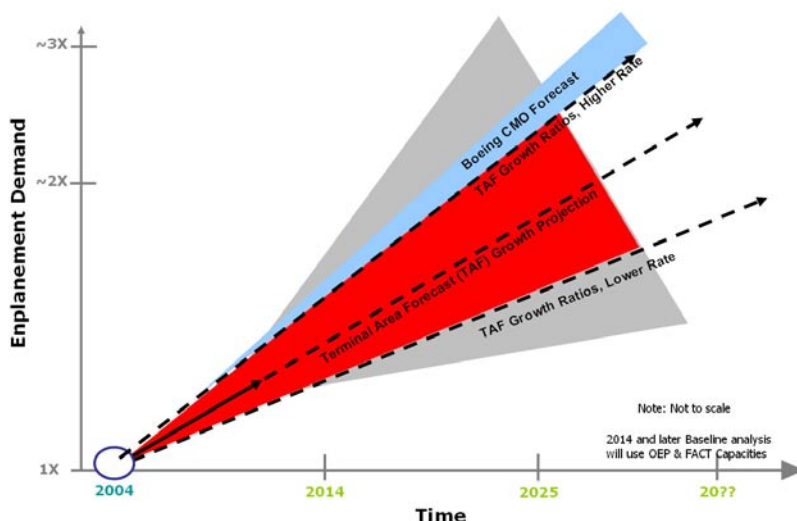


Figure 2 Notional Range of Future Demand Projections

Finding: Demand Drives the Need for Transformation

The JPDO used the tools of national airspace system modeling to first examine how increasing demand for en route airspace capacity would be constrained by the capabilities of the current airspace system design. Reflecting the Monitor Alert Parameter (MAP) value as a proxy for sector load constraints, simulations of traffic at twice the current number of flight operations per day were conducted. In an unconstrained system, the sectors shown in red and black in the illustration represent sectors in which the ratio of traffic demand to sector capacity ranges from 125% to over 200%. Doubling or even tripling the sector capacities (and therefore controllers) in this analysis failed to enable a throughput of a high enough level to allow unimpeded traffic flow. This illustrative finding demonstrates the need for transformation. (Note that even in the baseline case (2002) there are sectors in the analysis that cannot accommodate the required number of operation.)

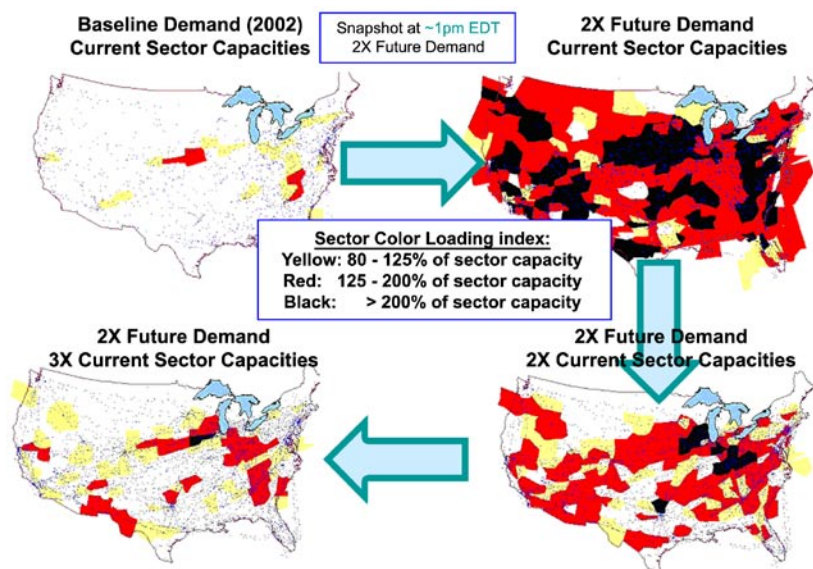


Illustration of Future Demand vs. Current Capacity

demand and capacity in the current and anticipated NAS. The "anticipated NAS" is the National Airspace System that will exist in future years with the future programs and investments for NAS improvements that are already in the pipeline. *A principal factor motivating the efforts of the JPDO is the understanding that this baseline system, even with the planned improvements fully implemented and operational, will not provide enough capacity to accommodate the levels and types of demand that it will face in future years.* Without a detailed understanding of the features of this baseline relationship between aviation demand and capacity, it will be difficult to estimate or attribute the benefits (in terms of improved system performance) of JPDO strategies (as reflected in the NGATS vision) for transforming the NAS.

It is important to be clear that for the purposes of these analyses, a baseline scenario refers to a

scenario for NAS capacity and demand in the present and in future years. This baseline scenario holds important features of NAS operations fixed across these years, even though the volume of aircraft operations increases in future years. The increase in the volume of aircraft operations is driven by growth in the demand for passenger and other aviation services, which increase naturally with growth in the economy and the population. Analysis of this set of baseline future demand and capacity characteristics provides a reference point that can be compared to performance under alternative specifications of demand/capacity representing the effects of transformation strategies contained in the NGATS architecture.

To define the "anticipated NAS", the JPDO treated the current air transportation system as its starting point. It took into account the planned improvements to airports and airspace that are underway as part of the FAA's Operational Evolution Plan (OEP). It also reviewed the Future Airport Capacity Task (FACT) report, which identified specific anticipated improvements in airport capacity as well as those U.S. airports that are expected to have shortfalls of capacity by 2020. The JPDO worked closely with both the OEP and FACT teams so that its capacity modeling efforts correctly reflected the best existing assessments of planned air transportation system capacity. Data from FAA, DOT and other sources were used, as appropriate, in the analysis. To ensure robustness of the analyses, a number of different NAS capacity models

were used and results from the models were then crosschecked.

A preliminary analysis has been completed to assess the ability of the "anticipated NAS" (OEP) and NGATS concept to increase airport and airspace capacities to accommodate up to 3X the current number of NAS operations while maintaining or reducing current levels of delay. The initial analysis assumes that the NGATS capabilities enable a 30% increase in airport capacities beyond those predicted in the OEP, and a 200% increase in airspace sector capacities beyond current capacity. Results based on NAS-wide simulations show that for 2X current (2004) demand, the planned OEP improvements can accommodate approximately 78% of the forecast demand, while the NGATS plan can accommodate approximately 89% of the demand. For 3X current NAS-wide demand,

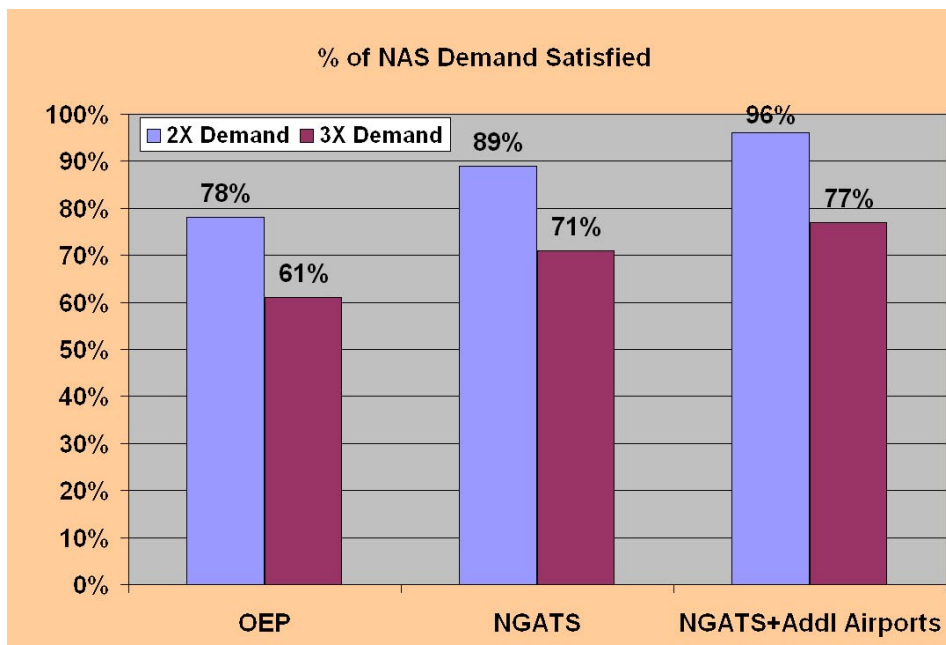


Figure 3 Initial Analysis of NGATS Impact on NAS Capacity

the planned OEP improvements can accommodate approximately 61% of the demand, while the NGATS concept can accommodate approximately 71% of the demand. In both the 2X and 3X demand scenarios, the use of additional airports in the vicinity of the OEP airports increases throughput to approximately 96% and 77% of demand, respectively (see Figure 3).

Next Steps

The JPDO's evaluation and analysis team works in close coordination with each of the IPTs to both develop and prioritize appropriate analyses of NGATS strategies. As the NGATS concept of operations continues to be evolved and matured by the IPTs, the team will perform iterative characterization and assessment of the extent to which strategies contribute to the achievement of the JPDO National Goals. While initial analyses have focused on the impact of the NGATS concept on NAS capacity, the next step will be to expand the evaluations to include quantification of the impact of NGATS on other critical aspects of NAS transformation such as safety, security, and the environment.

Conclusion

The ongoing role of the JPDO portfolio of simulation and modeling tools is to aid in comparisons between system capability and system performance. When such comparisons can be made, it becomes possible to conduct simulated experiments in which the effects of individual strategies or combinations of strategies are simulated within the NAS. As previously mentioned, the role of the baseline system

is to provide a starting or reference point for these comparisons. However, detailed description and characterization of the baseline system also improve the ability of the JPDO to identify the ways in which the baseline system will falter when it is confronted with future levels of demand. This contrast between baseline system capacity and baseline system performance – as identified in the simulation and modeling tools used by the JPDO – provides valuable information on areas that should be addressed by specific IPT strategies. In this manner, the evaluation and analysis team is able to **proactively** work with the IPTs to not only evaluate and assess the impact of the NGATS strategies, but to also refine existing strategies and help to define new strategies that will best

accomplish the NAS transformation to achieve the National Goals.

About the Authors

Dr. Sherry Borener is the Director of the Evaluation and Analysis Office of the Joint Program Development Office where she directs a team of researchers and analysts in the development and application of high-level models of aviation system performance. Prior to this assignment, Dr. Borener conducted many system performance and risk analysis studies for the Department of Transportation as well as other government agencies. Dr. Borener received her Masters of Public Policy and Ph.D. in Planning Degrees from the University of Michigan, Ann Arbor.

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¹ The JPDO evaluation and analysis team includes participants from key government and support organizations with a wide array of skills and knowledge including: a technical understanding of the air transportation system; the economic and policy issues that affect this air transportation system; environmental, safety and security requirements; and the capability to model various future states of this system.

² There are significant risks associated with plans or operational concepts that are based upon the NGATS that have clear policy implications: Should private investors be guaranteed a return (in terms of increased access, capacity, reduced operating costs, etc.) based upon the expected return of the NGATS? If the NGATS goals are changed or the implementation timeline is pushed out, can the government be held the liable and a does a mechanism exist for remediation of losses to private sector stakeholders?